High Level Architecture

Policy and Definition Process

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M&S Critical to DoD's Ability to Meet its Mission

Continuing squeeze on DoD resources

- shrinking, dispersed force structure
- competition for O&M funds limits field exercises
- need to carefully examine every investment

More demanding operational requirements

- new, more complex missions
- vastly expanding mission space
- increased complexity of systems and plans
- increasing demand for joint training
- security challenges (e.g., information warfare)
- no traditional way to address

Much more technical capability at less cost

- communications
- computers
- advanced software technology
- displays/human-machine interfaces
- data storage and management

DoD M&S Vision

Defense modeling and simulation will provide readily available, operationally valid environments for use by DoD components

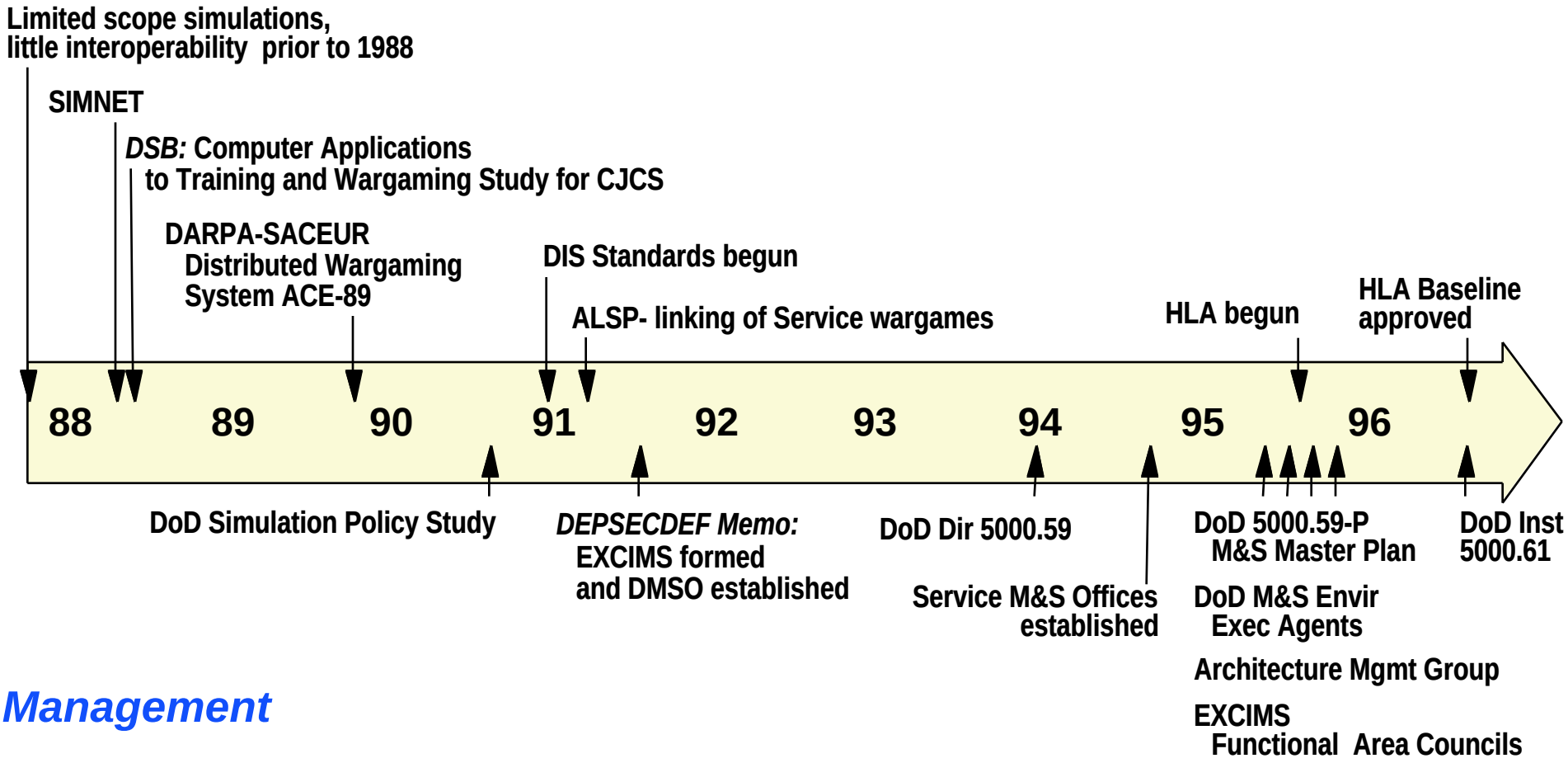
- ***to train jointly, develop doctrine and tactics, formulate operational plans, and assess war fighting situations***
- ***as well as to support technology assessment, system upgrade, prototype and full scale development, and force structuring.***

Furthermore, common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities.
To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.

DoD Executive Council on Modeling and Simulation (EXCIMS), March 13, 1992

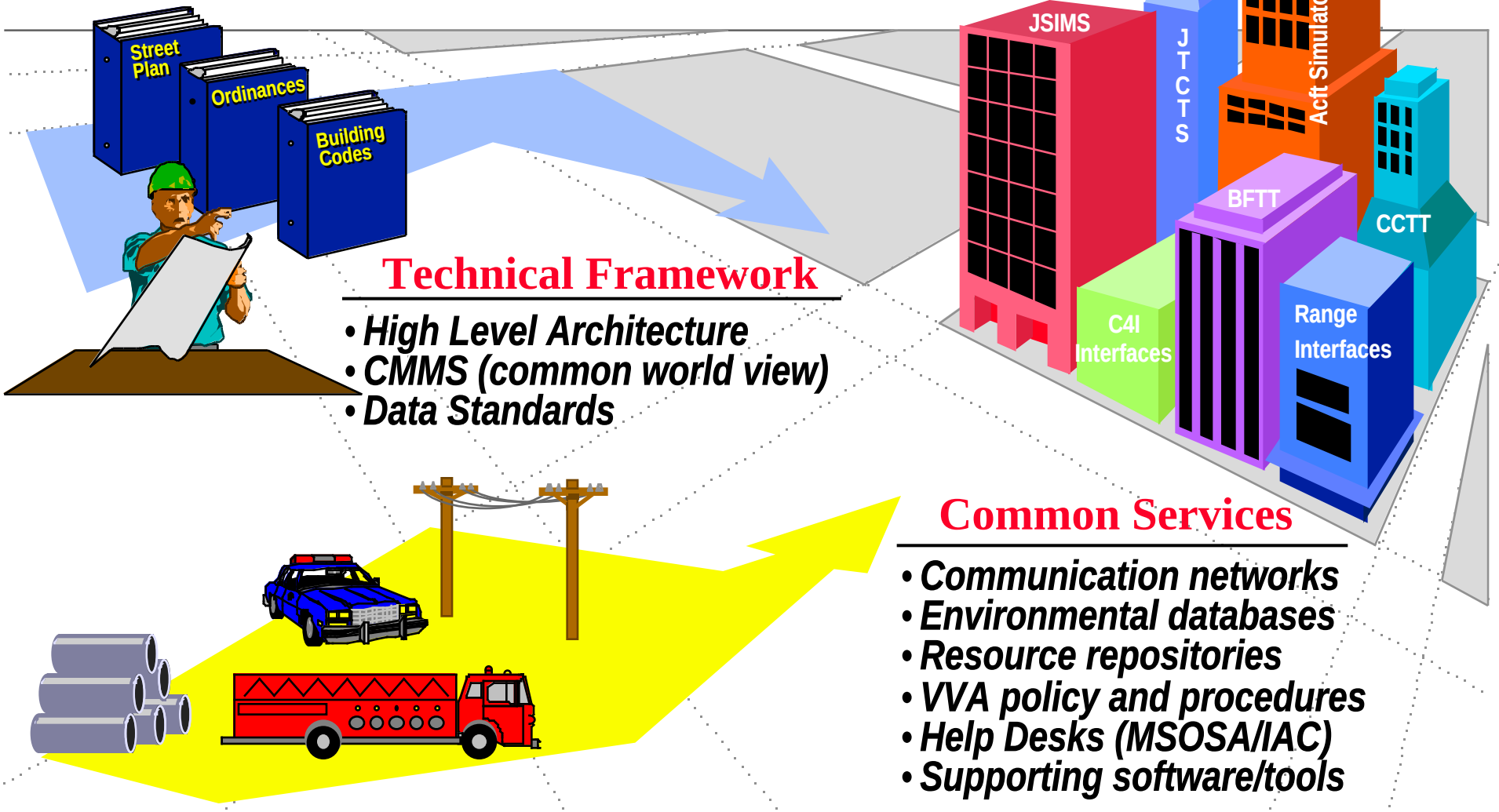
How Did We Get Here?

Technical



Management

DoD M&S Strategy:
An Analogy to City Planning



Technical Framework

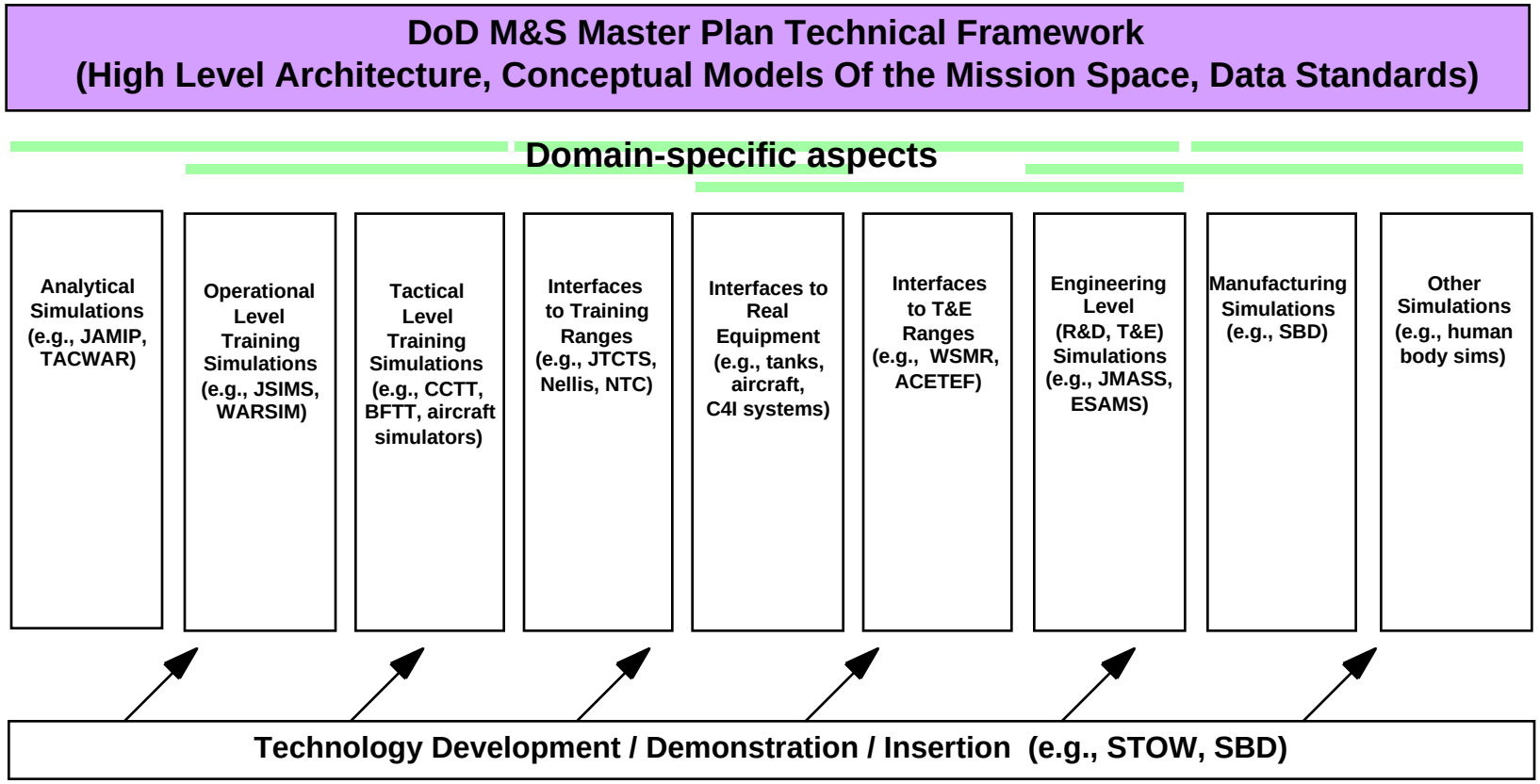
- *High Level Architecture*
- *CMMS (common world view)*
- *Data Standards*

Common Services

- *Communication networks*
- *Environmental databases*
- *Resource repositories*
- *VVA policy and procedures*
- *Help Desks (MSOSA/IAC)*
- *Supporting software/tools*

Payoffs: Interoperability and reuse = capability and cost-effectiveness

Diverse Applications Under a Common Technical Framework



DoD M&S Master Plan

Objective 1	*Objective 2*	*Objective 3*	*Objective 4*	*Objective 5*	*Objective 6*
Develop a common technical framework for M&S	**Provide timely and authoritative representations of the natural environment**	**Provide authoritative representations of systems**	**Provide authoritative representations of human behavior**	**Establish a M&S infrastructure to meet developer and end-user needs**	**Share the benefits of M&S**
Sub-objectives	***Sub-objectives***		***Sub-objectives***	***Sub-objectives***	***Sub-objectives***
1-1 High-level architecture	**2-1 Terrain**		**4-1 Individuals**	**5-1 Field systems**	**6-1 Quantify impact**
1-2 Conceptual models of the mission space	**2-2 Oceans**		**4-2 Groups and organizations**	**5-2 VV&A**	**6-2 Education**
1-3 Data standardization	**2-3 Atmosphere**			**5-3 Repositories**	**6-3 Dual-use**
	2-4 Space			**5-4 Communications**	
				5-5 Coordination Center	

signed out by USD (A&T) on 17 October 1995

DoD M&S Master Plan Objective 1-1

- **Objective 1-1**

- **Establish a common high-level simulation architecture to facilitate the interoperability of all types of models and simulations among themselves and with C4I systems, as well as to facilitate the reuse of M&S components**
  - **Simulations developed for particular DoD Components or Functional Areas must conform to the High Level Architecture**
  - **Further definition and detailed implementation of specific simulation system architectures remain the responsibility of the developing Component**

The Common Technical Framework, and specifically the High Level Architecture, represents the highest priority effort within the DoD modeling and simulation community

What is an Architecture?

- **An “architecture” defines the major functional components, design rules, and interfaces for a computer-based simulation system. It specifies (conceptually) how they hook together and work together as a whole**
- **An architecture is NOT the software which is required to implement it**

Why HLA Now?

- **DoD M&S Vision**
  - **“ ...common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities. To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.”**
- **DoD embarking on development of new generation of simulations**
- **Current technology (e.g., ALSP and DIS) does not provide tools necessary to achieve DoD M&S Vision**

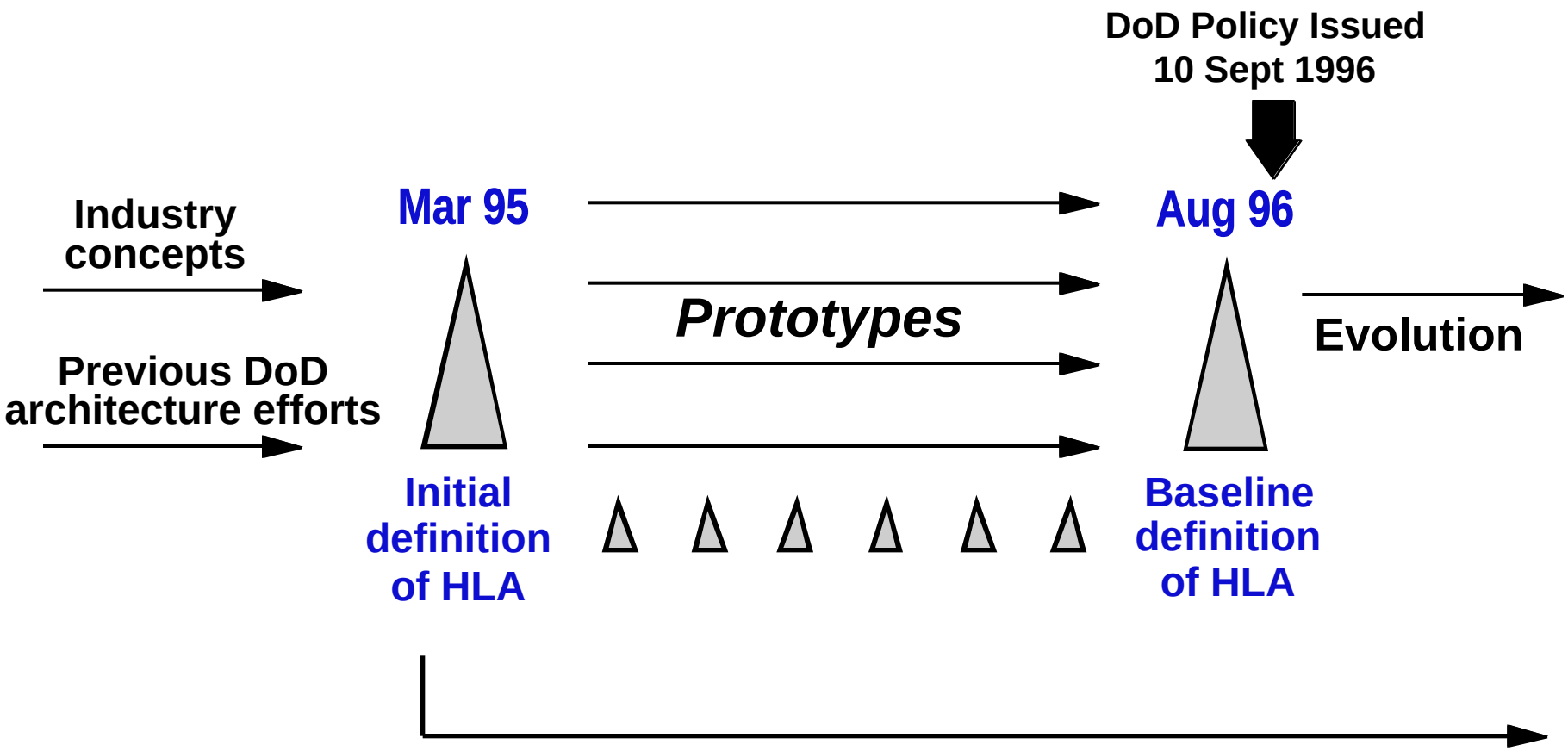
DIS

- **Applies to only real-time, platform level niche of M&S market**
  - **HLA applies to multiple time management schemes**
- **Embedding data in architecture has caused protocols to be inflexible and ineffective**
  - **HLA separates data from architecture; evolve data as required by applications**
- **DIS uses full broadcast distribution approach**
  - **Does not scale from a network or processor viewpoint**
  - **HLA selectively passes data among simulations**
- **HLA is built around simulation services that DIS does not possess**

ALSP

- **Applies to only discrete-event, logical-time niche of M&S market**
  - **HLA applies to multiple time management schemes**
- **Designed to accommodate legacy simulations**
  - **HLA new, more robust approach designed in from onset**
- **Evolution driven by JTC needs**
  - **HLA supports broad DoD user community**

HLA Development Process Overview



DoD-wide Architecture Management Group

(16 major simulation programs; developers were 35% government, 12% FFRDC, 5% academia, 48% industry)

HLA Designated as DoD's Standard Technical Architecture for Simulation

DoD Policy

"Under the authority of DoD Directive 5000.59, and as prescribed by [the DoD Modeling and Simulation Master Plan], I designate the High Level Architecture as the standard technical architecture for all DoD simulations."

Dr. Paul Kaminski
10 September 1996

HLA Policy

- "No Can" Dates

  "No Can Pay" - first day of FY99
  - no funds toward developing/modifying non-HLA simulations

  "No Can Play" - first day of FY01
  - retirement of non-HLA compliant simulations

- Components will review simulation projects/programs for HLA compliance by end of 2d Qtr FY97
  - results reported to and tracked by DMSO
- Supersedes current interoperability standards (DIS, ALSP)
- Waivers to HLA policy require USD(A&T) approval

Scope of HLA

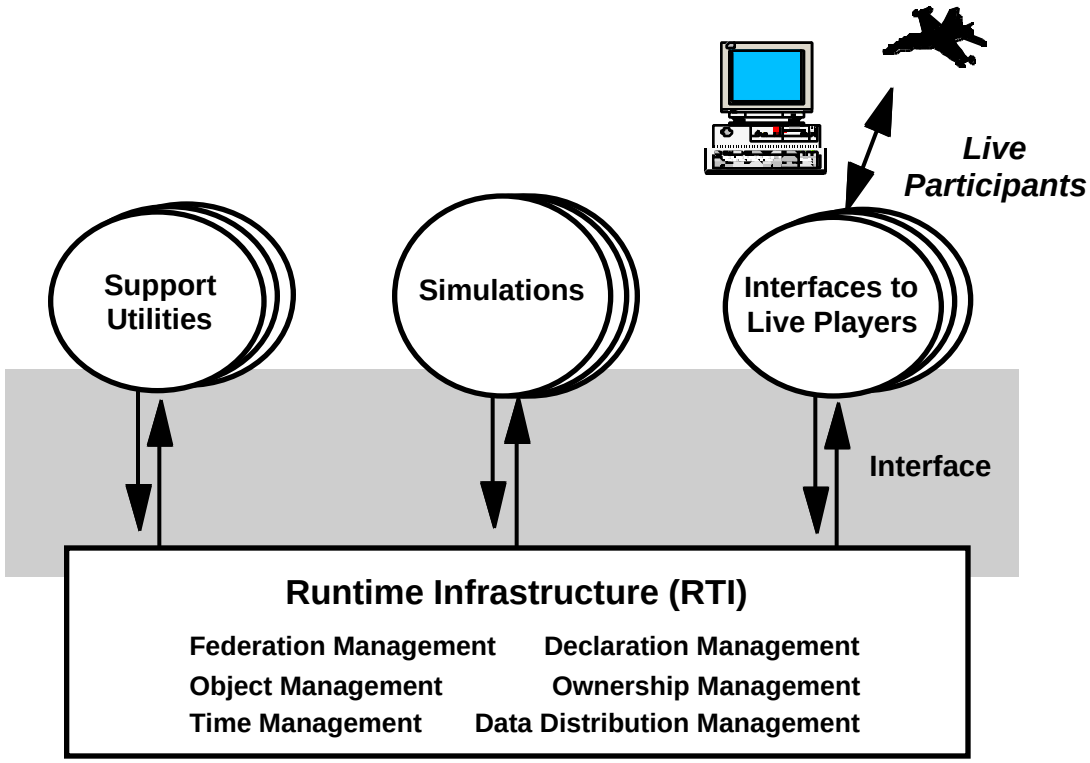
- **Applicable to broad range of functional areas (e.g., training, contingency planning, analysis, and acquisition)**
- **Applicable to simulations involving pure software representations, man-in-the-loop simulators, and live components (instrumented-weapon and C3 systems)**

Rationale for HLA Design

- **Basic premises**
  - **No single, monolithic simulation can satisfy the needs of all users**
  - **All uses of simulations and useful ways of combining them cannot be anticipated in advance**
  - **Future technological capabilities and a variety of operating configurations must be accommodated**
- **Consequence**
  - **Need composable approach to constructing simulation federations**
- **Resulting design principles**
  - **Federations of simulations constructed from modular components with well-defined functionality and interfaces**
  - **Specific simulation functionality separated from general purpose supporting runtime infrastructure**

The High Level Architecture (HLA)

- **Architecture calls for a federation of simulations**
- **Architecture specifies**
  - **Ten rules**
    - **define relationships among federation components**
  - **Object Model Template**
    - **specifies the form in which simulation elements are described**
  - **Runtime Interface Specification**
    - **describes the ways simulations interact during an operation**



The HLA is a standard and does not mandate a specific software implementation

HLA Supporting Software

- **DMSO is sponsoring development of several software applications/tools which facilitate HLA use**
  - **Runtime Infrastructure**
    - **FFRDC-developed 1.0 series (FAM Version now)**
    - **Commercially procured 2.0 series (Spring 98)**
  - **Object model development tools**
  - **HLA compliance testing tool**
  - **others TBD**
- **Will be provided as shareware**
  - **Have approval for international release of RTI**

HLA Technical Library

- **DMSO has established an online "public library" for the M&S community, available through the DMSO Web page**
- **Contents**
  - **HLA Baseline Definition (Rules, Interface Specification, Object Model Template)**
  - **HLA Glossary**
  - **Interface Specification Supporting Documents (Test Procedures, Time Management, API)**
  - **OMT Supporting Documents (OMT Extensions, Test Procedures)**
  - **HLA Compliance Checklist**
  - **HLA Federation Development Process Model**
  - **HLA Security Architecture**
  - **Additional briefings and documents**

On-Line Documentation

Proceedings and products of the AMG appear under the subtopic "Common Technical Framework for M&S", under "High Level Architecture". DMSO home page site is:

http://www.dmso.mil/

Specific questions can be directly addressed to DMSO via electronic mail at

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